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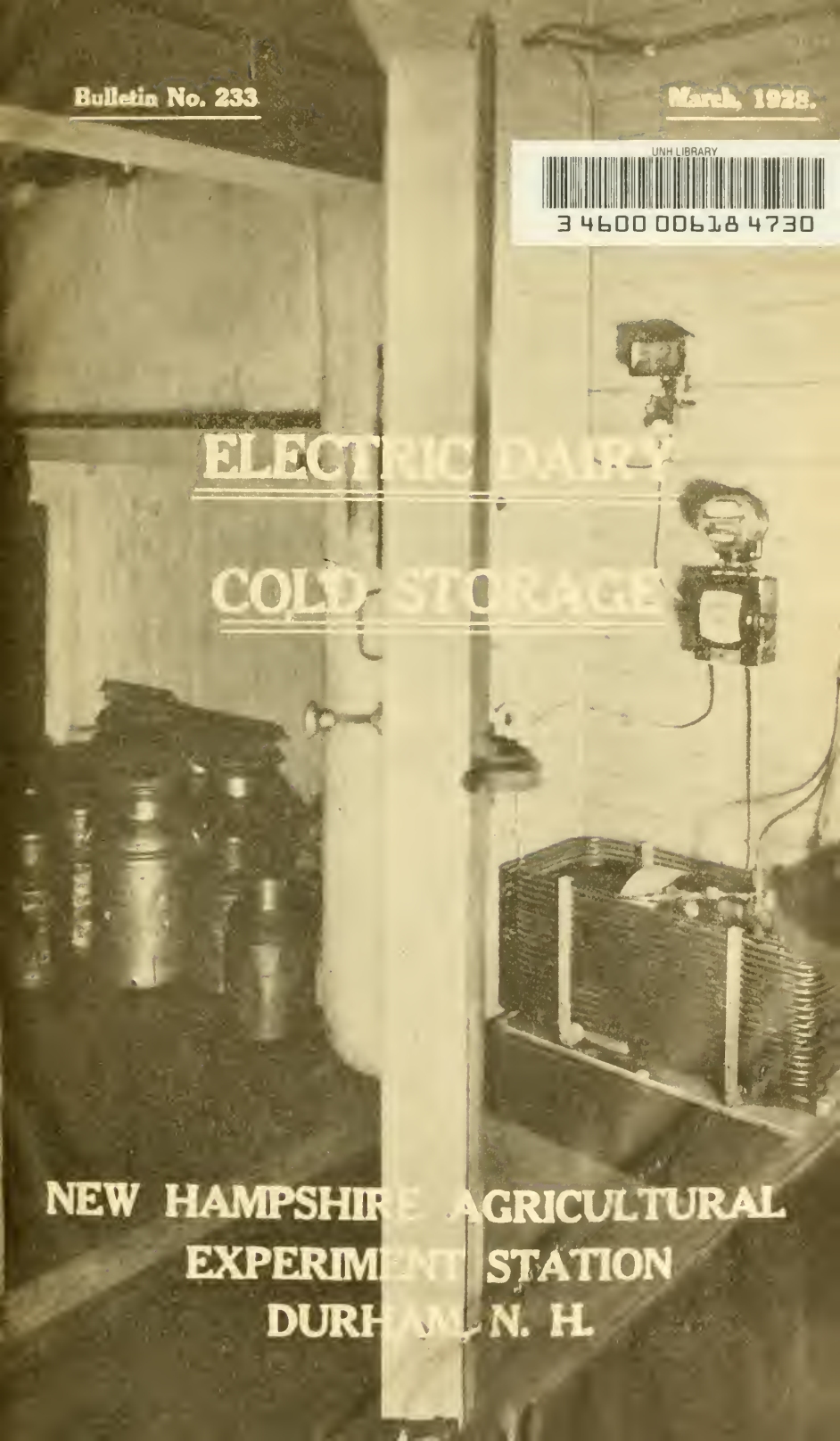

ELECTRIC DAIRY COLD STORAGE

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION
DURHAM, N. H.

ulletin 238 February, 1929

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

REPORT FOR 1928

UNIVERSITY OF NEW HAMPSHIRE
DURHAM, N. H.

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AGRICULTURAL EXPERIMENTS 1928

ANNUAL REPORT OF THE DIRECTOR OF THE NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

With the appropriations under the Purnell Fund now approaching their maximum, it may be well to consider what forward steps it has been possible to initiate as a result of this legislation. The detailed reports by projects will form the body of this report, but certain broad tendencies are easily observable.

One of the distinct advances has been the development of work in agricultural economics. This has been in accordance not only with the special subjects of the Purnell Act, but with the basic needs of agricultural research in the state. Already the economic studies made have given valuable information on fundamental problems.

No less important have been the long needed soil fertility investigations on typical New Hampshire soils. With the establishment of five series of studies, involving over 500 plots, it will soon be possible for us to give more definite recommendations on soil treatment to farmers in different parts of the state than ever before.

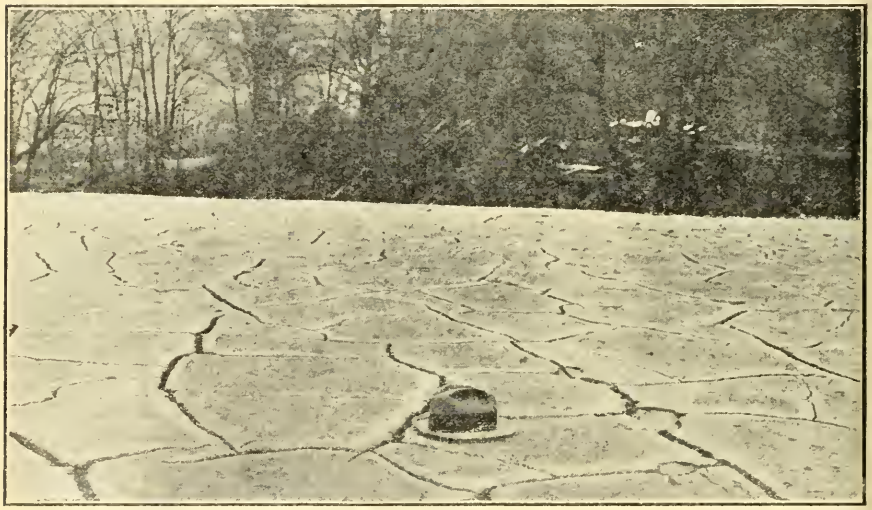
Similarly, research work in poultry has been started for the first time, as well as in home economics and rural electricity. New projects have also been initiated in horticulture, entomology, animal husbandry and dairying.

Many of these advance steps will be noteworthy, we believe, in the history of the agriculture of the state. On the other hand, it is with some chagrin that we must admit that it has not been possible to undertake the studies in rural sociology suggested by the Purnell Act, nor, in fact, to make more than a meager start in the field of home economics. The reason for this lies in the small amount of state funds which are available for research work. The Federal Government spent fourteen dollars last year in New Hampshire for every one expended by the state in the interest of agricultural investigations. Next year, the proportion will be even higher—eighteen to one. This is in marked contrast to the situation in other states, where the average expenditure this year has been two dollars of state to one dollar of Federal funds.

The state has very wisely, we believe, recognized the value of agricultural extension work, and in this field its appropriations have made possible an organization of which we have every reason to be proud. Funds for research are no less important: in fact, the ultimate success of extension work obviously depends upon the accuracy and comprehensiveness of the underlying investigations. We have been fortunate in New Hampshire in having a close working relationship between research and extension, both departments being conducted under the same head. It is time, however, for the discrepancy in appropriations to be removed.

FLOOD LANDS HELPED BY TESTS

Following the flood of November, 1927, Ford S. Prince obtained soil samples from the Connecticut River Valley, where fields were covered to a depth of ¼ to 20 inches with a deposit of silt. A series of tests made with the newly deposited soils in comparison with the old in the university greenhouses during the winter showed that while organic matter and available nitrogen were too low for maximum yields in the soils, the lack of available potash and phosphorus was the limiting factor. These preliminary tests were helpful in making definite crop plans for the following season. The plots which were manured at the rate of 20 tons to the acre, and the plots given 800 pounds of an 0-12-6 fertilizer produced good



Silt deposits like this, 24 inches deep, as a result of the flood in the Connecticut Valley caused a special soil problem during the year

crops of alfalfa, sweet clover and timothy. The plants grown on the plot treated with 200 pounds of nitrate of soda did poorly.

The new soils were found to be sufficiently sweet to grow alfalfa and other legumes without liming. Tests made of the hydrogen ion concentration by T. G. Phillips showed that the PH of the new soils varied from 6.8 to 8.32. The PH of the soils in the state varies, as a rule, between 5.0 and 6.0. *(State Fund.)*

SOIL FERTILITY STUDIES

The problem of soil fertility is of basic importance in the agriculture of the state, and in 1925 the Experiment Station started a series of studies on carefully selected sites in different sections of New Hampshire. Five of these series are now being conducted, the fifth having been started during the past year. The investigations, which are being supervised by Ford S. Prince and Thomas G. Phillips, include experiments with both grass and legumes on the Whenal Farm in Greenland, and one with dairy farm rotations on the Carter Farm at Boscawen. All three of these deal with

neglected hay lands. The fourth, a study with potatoes in a dairy farm rotation, is under way on the Jackson Farm in Colebrook, and the fifth, a study of legumes on a terrace in the Connecticut Valley, was laid out this fall on the Livingston Farm in Claremont.

Grass on Neglected Hay Lands

This has been the first year in which a harvest has been secured from all 63 plots of the grass experiment in Greenland, as difficulties were encountered in securing a stand in the reseeded, unmanured portion. It was a season of heavy rainfall, and the hay yields were consistently heavier than in 1926 or 1927.

Nitrate of soda at the rate of 100 pounds annually per acre gave significant increases on the old sod, both with and without manure. The increases ran 614 pounds on the original sod, 1,497 pounds with manure, and 1,709 pounds without manure, in each case contrasted with similar plots without nitrate.

Superphosphate, on the other hand, failed to give a significant increase, either with or without manure, except when used with nitrate of soda, where the stimulation seems to have been due to the latter material.

Lime has proved very beneficial to the growth of the grass in this field, returning 1,054 pounds for the two-ton and 1,396 pounds for the four-ton applications.

Legumes on Neglected Hay Lands

Fertilizer studies on 48 plots of alfalfa show to date that potash when applied singly gave a significant increase for both cuttings, and is the only chemical which has more than paid in increased hay yields for the cost of the fertilizer. Applications were at the rate of 150 pounds of muriate of potash per acre. All plots, including checks, had a basic application of 20 tons of manure and 2 tons of limestone per acre.

Of the other treatments, lime and phosphorus; manure and lime; manure, lime, nitrate and phosphorus; manure and phosphorus; and manure, lime and phosphorus gave significant increases in the first cutting; and manure; manure, lime, nitrate and phosphorus; and manure, lime, nitrate, phosphorus and potash gave significant increases in the second cutting.

Yields of the first cutting all were over 5,000 pounds per acre, except in the check plots and those receiving only lime without fertilizer applications.

Studies of sweet clover are being made on 32 plots at Greenland and also on the University Farm.

Dairy Farm Rotation on Worn-out Hay Lands

The indication that lime has a distinct effect upon the growth of oats was the principal point of significance last year in the 120 plots at Boscawen.

In 1927 the entire field was in corn. It was originally planned to seed to alfalfa, red clover and alsike clover separately with oats in 1928. Fall floods in the Merrimack Valley prevented the thorough preparation of the soil in 1927 so that in May, 1928, the plots were all seeded to oats alone.

No further fertilizer treatment was made directly for the oats, but the plots where lime only was applied averaged over 1,000 pounds increase

above the check plots and those where fertilizer without lime was applied. The highest yielding plots were those with three tons of limestone and 300 pounds of superphosphate per acre; the yield amounted to 4,585 pounds—more than a ton above the check plots. The carry-over of phosphorus and potash from the preceding corn crop did not seem to be in quantity sufficient to stimulate the yield.

Similar indications of the value of lime on oats were evident in the fertilizer studies at Colebrook. A portion of this field was seeded to oats about June 1, and the crop was harvested for forage. No fertilizer was used for the oats, but lime was applied on certain plots at the rate of two and four tons per acre. Increased yields for the two-ton application were significant, amounting to 455 pounds of hay, and the four-ton application did not give much better returns. *(Purnell Fund.)*

FERTILIZER STUDIES ON POTATOES

Scattering the fertilizer in the row with the seed has given a slight advantage for two years as compared with placing it above, below or at the side of the seed.

Studies of varying amounts of potash with fixed amounts of nitrogen and phosphoric acid were made during the year in duplicate plots on a worn-out sod land which had not been plowed or fertilized for 20 years or more. The fertilizer was applied at the rate of 1,500 pounds per acre but no manure was used. The average yields were as follows: Check plots, 148.2; 4-8-0 grade, 256.3; 4-8-3 grade, 292.7; 4-8-6 grade, 295.0; 4-8-10 grade, 313.9.

On other plots where manure was used without chemical fertilizers it was found that 12 tons of manure increased the yield 77 bushels over the check plot, and 24 tons increased it 117 bushels. With potatoes 80c a bushel this year, this gave a value of $5.13 for each of the first 12 tons of manure used, and $2.68 for each of the last 12 tons, with no allowance for any residual effect for succeeding crops. The manure was partially rotted and applied and hoed in just before planting. The results bear out those of a similar experiment two years ago.

Nitrate Versus Sulphate Nitrogen for Potatoes

With the prices of sulphate of ammonia and nitrate of soda the same per ton as they have been for the past two seasons, the question arises, "Can we substitute sulphate for nitrate in our potato fertilizer and thus cut the price?" To secure some data on this question, two plots were planted in duplicate, one with all the inorganic nitrogen as nitrate and the other with the inorganic nitrogen as sulphate. These were checked against a third plot with nitrate and sulphate mixed in equal proportions along with tankage as a source of organic nitrogen. In each case the fertilizer was a 4-8-4 grade applied at the rate of 1,800 pounds per acre.

The total yield of the sulphate plot was about 11 bushels per acre less than the other two, while its yield of No. 1 potatoes was 29 bushels less than either of the other two. Yields of both the nitrate and mixed plots were practically identical. While this one year's test was not conclusive, it seems to indicate that sulphate alone is not as desirable as a mixture of the two in a potato fertilizer.

A comparison of quadruple strength fertilizer with the ordinary grade

during the past year shows similar yields and no injurious effect from the concentrated brand. Plots were planted in duplicate, one with the ordinary 4-8-4 grade at the rate of 1,800 pounds per acre and the other with a 16-32-16 grade at the rate of 450 pounds per acre. Yields ran 295 bushels per acre for the former and 285 for the latter.

These fertilizer studies were made under the supervision of F. W. Taylor. *(Hatch Fund.)*

WHY AREN'T HOME GROWN POTATOES MORE POPULAR?

An analysis of New Hampshire's home markets revealed that in 1925 more than 135,000 bushels of potatoes were shipped into the state. To find whether New Hampshire wholesalers, retailers, restaurant and hotel managers preferred out-of-state produced potatoes, E. H. Rinear approached the problem from the middleman's point of view. He found that while the middlemen preferred the excellent cooking and eating qualities of New Hampshire grown potatoes, three factors influenced the majority to turn to out-of-state stock.

The wholesalers and larger retailers are unable to buy locally many carlots of well graded potatoes that have been graded to size with a mechanical grader. Well graded potatoes have proved in the past to be easier to resell and do not require the extra expense of regrading or consequent loss from unsalable stock.

The great majority of New Hampshire potato growers have preferred to speculate with their crop by holding until a desirable price is reached and then dumping their entire crop on the market almost overnight. Such a system does not provide a steady supply of potatoes of the same standard. Many local tradesmen would, if the opportunity offered, be eager to establish a connection with a local producer for a continuous supply of uniformly graded potatoes.

Occasional instances arose where growers insisted on selling and delivering potatoes to the consumer in small lots for the same price they had charged retailers. *(Purnell Fund.)*

POTATO PRODUCTION COSTS

In continuing the study of potato production costs in New Hampshire, M. F. Abell secured complete records from 176 farms that raised a total of 297,711 bushels of potatoes on 1,161 acres. Production costs for each acre in 1927 were higher than in 1926, due to increased costs of fertilizer, seed and other materials. However, in southern New Hampshire the season and yields were more favorable and final costs per bushel were lower than in the previous year.

The distribution of labor on growing and hauling potatoes to market was analyzed for two years, 1926 and 1927. The larger yields of 1927 resulted in a slightly larger labor cost consistently higher for each operation. In 1927, 47.6 hours were spent on each acre for digging, 20.1 hours for hauling to market, 14.5 hours for planting, 10.9 hours for cultivating, 5.5 hours for fitting the soil, 5.4 hours for spraying or dusting, 2.2 hours for manuring, 6.0 hours for plowing, and 2.7 hours for miscellaneous operations.

Since late blight was prevalent in unsprayed fields, an excellent opportunity was offered to compare the results of one year's effectiveness of sprays and commercial dusts in controlling diseases and insects. The dif-

ference in yields between the two groups of fields was very small. Commercial dusts cost about 20 percent more than the sprays for the same areas. Because of ease of application and the manner in which it fits into present practices, dusting is more frequently done on the smaller areas. Dusts are more effective on moist plants and may be applied when the hay is too wet to handle. Spraying, however, must be done when the plants are dry, which often interferes with the haying and consequently may be delayed. *(Purnell Fund.)*

WHY DOES POTATO SEED RUN OUT?

Attempts to develop potato seed stock in southern New Hampshire have thus far failed, due to deterioration from leafroll; and studies have been conducted by O. Butler, comparing seed at East Kingston and Northwood with northern-grown seed at Colebrook.

At Northwood a plot was established in 1926, as there was some reason to believe that the locality, while situated in the same county as East Kingston, was better suited to seed growing because of its higher elevation. The seed planted in 1926 produced 4.48 percent leafroll plants, but no mosaic was detected. In 1927 the seed was carefully greened before planting and 3.57 percent weak-sprouted tubers were removed. The amount of leafroll that developed in the field was 2.75 percent; in other words, the stock was better than it had been the year before. Yet the seed saved from the plot, when greened in 1928, was found to contain 39.3 percent weak-sprouted tubers. The stock was worthless.

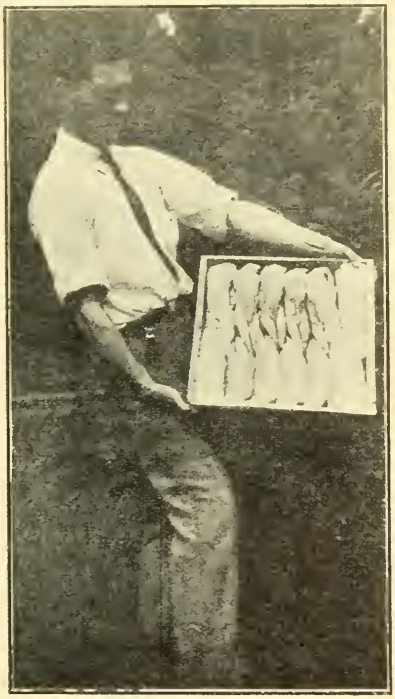
At East Kingston potatoes harvested 90 days after planting deteriorated completely in 4 years. At Northwood the stock used was worthless after two seasons.

It is to be noted that at Colebrook, seed from the same original source as was used at East Kingston and Northwood shows after seven years no material deterioration. The question arises whether the difference may not be due to temperature. The mean temperature during the growing season for the three stations has been: Colebrook (4 years) 15.12° C.; East Kingston (5 years) 16.78° C.; Northwood (2 years) 16.80° C.

At East Kingston the mean number of hours per day above 25° C. for 5 years has been 2.51 hours per day, at Colebrook 1.6 hours per day. It is to be noted that mosaic plants exposed to a temperature above 25° C. of 1 hour per day still show mosaic symptoms, but when the exposure is lengthened they become obscure and eventually disappear. Mosaic is the prevailing degeneration disease of potatoes at Colebrook; leafroll is the prevailing degeneration disease at East Kingston and Northwood. The mean number of hours per day the temperature is below 10° C. is apparently of some significance, being 4.3 at Colebrook and 3.1 at East Kingston for the period covered. But for the four years in which we have comparative data, there have been two years in which there were practically twice as many hours per day below 10° C. at Colebrook as at East Kingston, and two years in which the number of hours below 10° C. at both stations was practically the same. Leafroll shows no tendency to increase at Colebrook, but it has shown very marked increase at East Kingston in the two years in which the number of cool hours per day at the latter station was only half the number at the former. *(Purnell Fund.)*

WHITE MOUNTAIN HOTEL STUDIES

Further study of the White Mountain hotel demand was made last summer by E. H. Rinear, to learn in greater detail the preference for vegetables and poultry products. In general, information was obtained for ten vegetables concerning the variety, size, shape, color, texture, firmness, grade or brand, style of package, price paid, source and amounts used weekly. Similar data were collected regarding dressed poultry to find out the amount of broilers, roasters, and fowl used weekly, also to learn the color, weight, brand, package, source and prices paid. Information was also obtained for eggs regarding brand, price, source and amounts used.



Fancy packed broilers of the type desired by White Mountain hotels

One of the large White Mountain hotels used in a week during the height of its season in August the following amounts of vegetables: 6 bushels string beans, 6 bushels lima beans, 8 bushels carrots, 140 dozen ears of sweet corn, 4 boxes slicing cucumbers, 10 boxes of lettuce, 21 bushels peas, 9 bushels spinach, 5 bushels tomatoes, 2 barrels of cabbage, 4 boxes celery and 6 boxes of Romaine, besides many other vegetables. The amounts of dressed poultry used weekly by this hotel in the three classes studied in this investigation were: 28 dozen broilers, 400 pounds of fowl, 400 pounds of roasters, while 21 cases of eggs were necessary to supply its demands.

In many instances very definite reasons were given by the stewards and chefs as to why they desired certain qualities in the vegetables and dressed poultry or a particular brand of eggs. New Zealand spinach is preferred to the crinkly type because it is easier to wash; firm, compact heads of lettuce are desired because they take less dressing; tomatoes must be uniform in size and of even color when used for salads. In nearly all instances, broilers were desired of the white-feathered breeds because the light-colored pin feathers are not so conspicuous as those of darker breeds. This color choice was not emphasized in reference to roasters or fowl because they are served differently. A common complaint regarding the local dressed fowl or roasters was that it had not been confined and fed a fattening ration a week or ten days previous to killing. As a result the meat was tough and stringy. One brand of eggs was demanded almost entirely because of careful grading. The stewards stated that it was necessary, in satisfying their discriminating guests, that the egg yolks

should be of the same color and that ninety percent of the eggs from this particular brand equalled the color requirements.

The general impression resulting from the study is that this demand is a very exacting one, which requires a high degree of specialization. In those instances where local men have attempted to supply the hotel trade and have failed, it usually was because of poor grading and packaging and lack of sufficient volume to supply the hotels regularly. There are, however, a few growers in the White Mountain hotel district who are giving satisfactory service and supplying vegetables of better quality than can be purchased from Boston distributors. New Hampshire poultrymen are at a disadvantage in competing with the agents now furnishing poultry products to the hotels because the agents are equipped to assemble in large quantities and therefore to grade and package their products satisfactorily. *(Purnell Fund.)*

RANGE IN GRAIN COSTS FOUND

Important variations in the price charged for grain are indicated in the studies of grain store costs which have been continued during the past year by E. H. Rinear. Retail cash prices have been procured on the weekly basis from 53 representative dealers in the state, and at the same time the prices from a large number of wholesale distributors have been regularly used. The largest difference in retail prices thus far appeared for poultry wheat, where there has been a range running as high as 75 to 95c. Corn and oat prices have shown the smallest variation, the former differing from 20 to 30c a hundredweight, and the latter from 8 to 12c a bushel. Studies are also being made of scratch grain, dry mash, dairy feed, stock feed, cotton seed, gluten, bran and middlings. The investigation will be continued to show the relation existing between price levels; to measure the time lag in the extent of price changes; to classify the dealers into groups to show those who follow the markets regularly, those who ignore it entirely, and those who follow it only part of the time; and to measure the value of business on the operating cost and on margin and retail prices in grain. *(Purnell Fund.)*

MARKETING LIVE BROILERS IN NEW YORK CITY

A completed survey of the problems involved in marketing live broilers in New York City shows that New Hampshire has been leading in the development of the early live broiler industry. During the past three years approximately half of the broilers received by seven large commission firms in New York during the early part of the season came from within this state. H. I. Richards, M. F. Abell and E. H. Rinear conducted the survey and analyzed the results.

The high prices which gave the industry its initial impetus have been dwindling. The top price quotation has declined steadily each season from $1.15 a pound in 1921 to 55 cents in 1928. This occurred in spite of the lengthening of the season, which, instead of opening in March as in 1921, now opens even in December. About 80 percent of New Hampshire broilers brought the top market price.

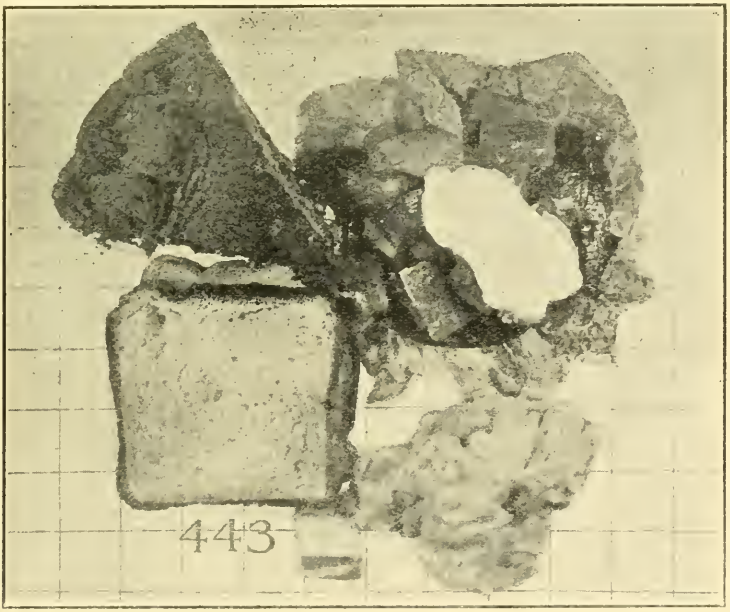
Religious festivals during the early months of the year have a marked effect on the weekly demand for broilers in New York, it was found.

The total marketing costs of 265 shipments of broilers weighing 135,495 pounds amounted to $10,355, or $ .076 a pound, with shrinkage the largest factor. Further details have been published in Bulletin 234. *(Purnell Fund.)*

STUDIES IN HUMAN NUTRITION ARE BEGUN

A survey of the nutritive value of foods available for purchase in Durham and nearby towns is being conducted by Miss A. Gertrude Farr in co-operation with Dr. F. G. Benedict, director of the Nutrition Laboratory of the Carnegie Institute of Washington.

Oxy-calorimeter combustions and Kjeldahl determinations have been



How many calories in this supper? Studies of typical meals were made at the nutrition laboratory

made with 470 food samples, and the calories per gram, the total calories, and the total amounts of protein have been computed. The samples were obtained from restaurants, the University Cafeteria, drug stores and creameries.

Meals served by the resident students living at the home economics practice house were analyzed for twenty-one consecutive meals and were found to average 2,450 calories and 61 grams of protein per day.

A summary in which 66 candies were grouped according to composition, shows that a bar made from chocolate and nuts contains more calories per gram than a candy with a nut and caramel center. Other groups, which

have a distinct caloric value, are chocolate-coated cocoanut candies and chocolate-coated bars with cream centers.

One pint of chocolate milk shake made by the college creamery furnished 448 calories and 14 grams of protein. *(Purnell Fund.)*

STUDIES ON FRUIT BUD FORMATION

The work on fruit bud formation consists of three phases. The first is concerned with the long term experiment in the Woodman Orchard; the second, a new series of experiments more recently inaugurated, deals with the effect of time of application of fertilizers upon the flower formation processes; and finally, the chemical composition of fruit spurs as related to initiation of flower embryos is being investigated.

Experiments with the Woodman Orchard continued by G. F. Potter have now completed their 19th year and show that the various plots may be classified as to growth and yield in five classes, depending on the amount of nitrogen available. The trees in permanent sod, where nitrogen supply is exceedingly limited, have an average yield of 40 pounds. Those that are cultivated in alternate years and therefore have a slightly larger supply of nitrogen, averaged 66 pounds per tree. Plots cultivated each year averaged 76 pounds of fruit a tree. Yields in four plots cultivated annually, which have in addition received a fertilizer containing 2 pounds nitrate of soda per tree, range this season from 124 pounds per tree to 191 pounds. The average for the group is 152 pounds. The last plot, which is cultivated, received 6 pounds of nitrate of soda per tree, and the yield is distinctly more than any other plot in the orchard, with 290 pounds of fruit per tree for this season. These results indicate that in a cultivated orchard fertilizers may need to be applied for some time before the benefits become apparent, and that ultimately they may materially affect the yields and the productive life of the trees.

The Influence of Time of Application

A study of the influence of time of application of nitrogenous fertilizers is being carried on with Baldwin, Rhode Island Greening and McIntosh varieties in three different orchards. The plan of experimenting with paired trees was adopted, and two trees of each pair were selected for similarity in both tree characters and soil conditions. One tree of each pair was given the special fertilizer treatment to be tested, and the other an application made in the spring in accordance with prevailing practice in this section.

Complete records were made by means of random counts of the percentage of spurs forming flowers in each tree, the percentage of blossom spurs which set fruit, the yield of fruit per tree and the average size of the fruits. Individual trees show a good deal of fluctuation and the records for this season do not support any conclusion that the time of application of fertilizer has produced a significant change in flower formation, percentage of set, yield, or size.

During two previous seasons a plot of Baldwin trees in the university orchard, which receives a mid-summer supplementary application of nitrate, produced about 30% higher yield than the checks. The yield was higher than for the check trees during the present season but the difference may hardly be considered significant. Since the Baldwin and Greening varieties

are decidedly biennial in bloom it is probable that the fluctuation over a series of years would not be as great as these reported in this, the first season in which complete data were taken.

Chemistry of Fruit Bud Formation

An extensive investigation of the chemical constituents of fruit spurs has been conducted by G. F. Potter and T. G. Phillips. Spurs were studied from 26 different plots of Baldwin trees which showed a considerable variation in fruit bud formation, ranging from about 2 percent to practically 60 percent. The analyses for dry matter, soluble and insoluble solids, reducing sugar, sucrose, phlorizin, starch, acid hydrolyzable material, soluble and insoluble nitrogen, were studied statistically to determine the constancy of the relation between the amount of each substance present and the proportion of spurs forming flowers. The results indicate that a primary relation with fruit bud formation could be established only with the size of the spur as measured by dry weight or soluble and insoluble solids and with the percentage of nitrogen present soluble, insoluble, or total.

Work completed by L. R. Tucker this year indicates that with Baldwin apple trees growing under New Hampshire conditions, the greatest terminal twig growth is made during the year when the tree or branch is bearing fruit. In classifying the growth of 1,000 branches, it was found that bearing branches from bearing trees made the greatest terminal growth. Non-bearing branches on trees which had fruit on other branches made the next best growth, and the least growth was made by the branches on non-bearing trees. Fruit bud formation, however, is in the reverse proportion, being greatest on the non-bearing trees, next greatest on the non-bearing limbs of the bearing trees, and practically absent in the case of bearing limbs on bearing trees. *(Adams Fund.)*

FINDING THE VALUE OF THINNING APPLES

A study of the effect of thinning on the size and market value of the fruit and crop of Baldwin apples was started by H. A. Rollins. Pairs of trees, similar in size, set of fruit, and growing under the same soil conditions, were selected. One tree of each pair was thinned and the other not. Five such pairs of trees were used in 1928 in each of four orchards in different localities in southern New Hampshire. At harvest time eight random samples of 25 apples each were picked from each tree, from high and low positions, on the east, west, north, and south sides of the tree. The diameter of each one of the 200 apples from each tree was accurately measured, the percentage of the colored surface estimated, and a record made of all types of defects and blemishes.

The records show that the size of the fruit and the amount of color is increased by thinning, but these benefits were accompanied by a decrease in the total crop, which in large measure affects the benefits. On a percentage basis the fruit from the thinned trees appeared much better than the fruit of the unthinned. Thinned trees showed a considerably higher proportion of fruit of the large sizes. However, when this is calculated to the total number of pounds of fruit of each size on the tree, the thinning was not a paying proposition. The thinned fruit was superior in color and freedom from blemishes, but probably not enough to affect the results to any marked

degree. The thinning in this case was not as severe as that which is ordinarily recommended, and was done in late July and early August. *(Purnell Fund.)*

CHANGES IN APPLES DURING STORAGE

A study of the changes occurring in apples during storage was begun by L. P. Latimer. Duplicate lots of three sizes of Baldwin apples (large, medium and small) were stored respectively in common storage at Wilton and cold storage in Manchester. At Manchester a temperature of 31°-32° F. was maintained throughout the season. The atmosphere in the Wilton storage was kept moist by water passing through channels in the room. A temperature of 30°-35° F. was maintained from November 15 to March 20. A temperature around 37° F. was then maintained until early in May. The temperature subsequently rose to 50° F. by June 20.

In general there was a tendency for the apples to ripen a little more rapidly in common storage than in cold storage. This was indicated by a change in the ground color of the fruit from green to pale yellow.

Large apples yellowed up sooner than small ones in both storages, but apples of a given size assumed the yellow ground color sooner in common storage than in cold storage. In every case the largest apples were always more attractive and better flavored than the small sized fruit.

In general the electrical resistance of the apple tissue was lowered about 10 percent during the first two months of storage under both conditions. There was then an increase for a period of six weeks, followed by a decrease again for six weeks. After this date there was no further change in the resistance of the tissue of apples stored at 32° F. There was, however, a large increase in fruit tissue resistance in common storage, amounting to about 23% between April 15 and June 20, when the experiment ended. A somewhat greater electrical resistance was constantly observed in the smaller fruits.

The pressure test (showing the number of pounds pressure necessary to puncture the skin and flesh of the fruit with a plunger ¼ inch in diameter) was generally lower in the common stored apples than in the cold storage lot.

There was little or no consistent difference in pressure tests of fruit of different size.

The changes in hydrogen ion concentration (PH) during the storage period were observed at intervals of two to three weeks. Generally the curve for PH was nearly identical for apples stored in both common and cold storage. Also the fruits of different sizes varied very little from one another during the season. *(Purnell Fund.)*

ELECTRICAL EQUIPMENT FOR FARMS

The three years' program on the relation of electricity to agriculture is now complete on seven New Hampshire farms. Representative dairy, poultry, fruit and general farms were chosen. W. T. Ackerman, in cooperation with the state and national committees on the Relation of Electricity to Agriculture, secured data on the efficiency of about 100 pieces of electrical equipment on these farms. The amount of the equipment returned at the end of the three years' trial indicates in the farmers' judgment the comparative values. Purchases were made at a discount.

On the first farm, a 3-man dairy farm, using $3,275 worth of equipment, six of the 22 pieces of equipment were returned, including a hot water heater, vacuum cleaner, sewing machine motor, 7½ horse-power portable motor, 1½ horse-power shop motor, and yard and building flood light. The investment on this farm was exceptionally high.

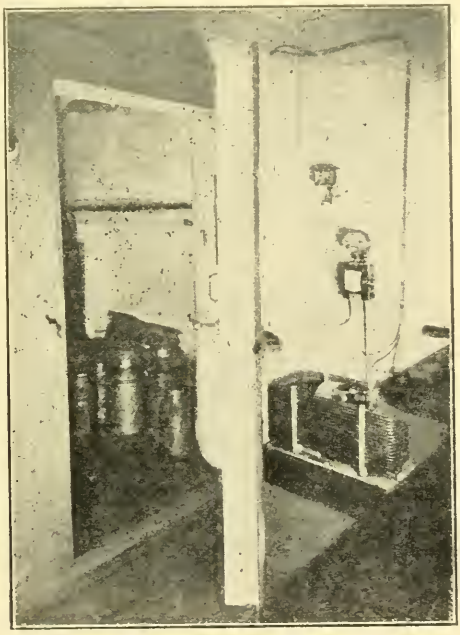
The second farm, a 3- or 4-man dairy farm, returned only one of 14 machines, the battery charger, from a total equipment costing $1,675.

On the third, a wholesale dairy farm, about $1,650 worth of equipment was installed, and none was returned.

On the fourth dairy farm, of a total of $2,519 worth of equipment, only one of 21 pieces was returned, a hot water heater.

On the fruit farm apparently less opportunity for electrification outside of the home was found than any of the other types. Only 11 machines, costing $1,842, were installed, but none were returned.

On a 3-man poultry farm, about $1,976 worth of equipment was bought,



Dairy cold storage proved one of the most valuable electrical investments on the experimental farms

and three of 16 items were returned, including the hot water heater, electric refrigerator, and poultry drinking fountains.

The types of equipment that the farm women thought most desirable within the house were flatirons, fireless cookers, percolators, curling irons, washing machines, vacuum cleaners, household refrigerators, kitchen ranges, sewing machines, lights, waffle-irons, oscillating fans and dish washers. Two homes kept the hot water heaters as a convenience in spite of a higher maintenance cost.

Barn equipments retained were milking machines, motors, cream separators, water pumps, hay hoists, concrete and fertilizer mixers, flood lights and dairy cooling rooms.

Detailed cost records for electric dairy cold storage were kept on three retail dairy farms. The initial investments for mechanical refrigeration were from $635 to $766 for an annual load of 9 to 12 hours with 300 quarts of bottled milk daily. The annual current consumption varied from 772 to 1,479 kilowatt hours a year, and the cost of the current ranged from $37.31 to $75.60. Power rates varied from a little over 3c to 7c a kilowatt hour. Figures from the same farms on the total cost of cold storage with natural ice indicate an average of twice the cost of the electrical method. The saving is principally one of labor; in fact, the expenses for operating refrigerators were in general less for ice. The initial investments for ice houses were about $200 less than for electrical equipment. Further details are given in Station Bulletin 233. *(Miscellaneous Income.)*

DETERMINING THE AMOUNTS OF SPRAY RESIDUES

Determinations of the amounts of arsenic and lead residues on apples have been made by S. R. Shimer. None of the apples taken from the 1927 crop carried lead or arsenic in amounts approaching the limits of the British tolerance. It was desired to determine the small amounts of these elements present with considerable accuracy, so that such relations might be studied as that between the placing of the apple on the tree and the spray residue carried.

The procedure followed allowed the accurate placing of the apples in the following groups: (1) those carrying not more than one-fourth of the tolerance limit; (2) more than one-fourth and less than one-half of the tolerance limit; (3) more than one-half and less than three-fourths; (4) more than three-fourths and less than the limit, and (5) more than the tolerance limit.

When the tolerance limits are reached, the amounts of the elements can be determined with considerable accuracy. *(Purnell Fund.)*

CALCIUM ARSENATE TESTS

Calcium arsenate when combined with lime sulphur results in less russeting than arsenate of lead with the same fungicide according to a six years' experiment by O. Butler and W. L. Doran. Only the faintest russet on the fruit and no foliage injury followed the use of lime sulphur solution 1-50 plus 1½ pounds of calcium arsenate to 50 gallons for the prepink and calyx sprays. The maximum injury produced during any year was a smooth, net-like russet, which occurred in 1923. Within the last three years no russeting has occurred at all. During the same years fruit sprayed with lime sulphur and arsenate of lead showed some russeting.

In laboratory tests acid arsenate of lead in itself showed a power to kill the spores of the causal organism. Under field conditions, however, no control was obtained. Further details are published in Technical Bulletin 36, "Spray Solutions and the Control of Apple Scab." *(Hatch Fund.)*

THE BASAL METABOLISM OF SHEEP

The basal energy requirements of sheep have been studied by E. G. Ritzman during the past year in co-operation with Dr. F. G. Benedict of the Carnegie Institution of Washington, D. C. Very litt'e definite information on this subject has been available hitherto with this important class of farm livestock. Since this laboratory has established the fact that the basal, or maintenance, requirements for energy of adult beef steers is 1,300 calories per square meter of body surface instead of about 900 calories as was formerly assumed, it has become a problem of economic as well as of physiological interest to determine the definite demands of sheep for this purpose.

Over 100 respiration experiments have now been carried out on sheep during the past seven years, and the results are being prepared for publication.

A new type of respiration chamber, especially designed for this investigation by Dr. Benedict, has been used. It is believed to be the simplest form of apparatus so far conceived for such studies, and its use promises to offer a great advance in indirect calorimetry. *(Adams Fund.)*

FASHIONS IN WOOL COVERING UNPROFITABLE

Attempts to breed sheep with points of fashion strongly in mind quite frequently have a negative effect on the animal produced, finds E. G. Ritzman from his sheep breeding studies.

In registered purebred sheep definite types or patterns of wool covering over face, ears and legs peculiar to any one breed must form the index of homogeneity of visible traits by which breeds are distinguished from each other. Most of these breed characteristics have of course a utility basis which is exhibited in the improvement of conformation of function;

Wool coverings on the face like the above are only a point of fashion, and breeding for such characteristics is at the expense of other more important factors

but present breed standards also require characteristics which have no utility value but which supposedly enhance the appearance, and may, therefore, be classed merely as points of fashion. Among these latter, wool covering over face, ears and legs is an outstanding example. It has been found that all breeds are genetically more or less heterozygous with regard to these individual traits so that selection for mating with the improvement of any one characteristic in view is often accomplished at the expense of some other trait, particularly when there is no correlation. Thus the problem of maintaining a high standard of perfection in a group of traits

increases with the number of different traits and with the number of the so-called genetic factors or genes which are operative in their formation.

As the sales value of wool growing on head, ears and legs is practically nil, even from those breeds which have the heaviest growth over these parts, it appears that adherence to this fashion may form an impediment to maintenance of a high order of other and more necessary attributes and thus add to the difficulties of that already complex problem of animal breeding. Details of this work were published during the year in Technical Bulletin 37. *(Adams Fund.)*

SOME PHYSICAL AND PHYSIOLOGICAL ACTIVITIES OF DAIRY COWS

To compare the physical and physiological activities of dairy cows under conditions of modern herd management with those of cows under laboratory tests, J. M. Fuller completed an investigation of the daily activities of the cows in the university dairy herd. In all, 58 cows and 15 of young stock were observed.

Details as to the percentage of time spent in lying and standing, amount of water consumed, amount of urine and feces voided, time spent in eating and ruminating, number of jaw movements per minute and respiration and pulse rates are given in Technical Bulletin 35. *(Purnell Fund.)*

VISCOSITY IN ICE CREAM

Trials under ordinary commercial conditions on regular commercial ice cream mixes were made by H. F. Depew to determine the effect of viscosity on overrun and texture and the effect of certain factors on viscosity.

Two types of viscosity exist in a commercial ice cream mix, apparent and basic. The apparent viscosity is very largely destroyed by stirring or agitation, while the basic or real viscosity is not affected. The destruction of the apparent viscosity does not seem to affect the overrun obtained or the ease of obtaining it.

Homogenization increased the viscosity of the mix by causing a greater dispersion of the fat and by increasing the fat surface exposed. It also caused a greater clumping of the fat and an increased absorption of protein upon the fat surface. An increase in the pressure of homogenization caused an increase in viscosity due to the greater dispersion of the fat particles and increased clumping of the fat.

Details of the experiments are being published in a separate bulletin. *(Purnell Fund.)*

ANTI-RACHITIC FACTORS IN CHICKENS

Five percent of fish meal in conjunction with the regular rations prevented the development of rickets in chickens in tests made by H. O. Stuart. Two percent of cod liver oil and of cod liver meal were equally efficient, and the birds having these made better growth than those with fish meal. Details have been published in Circular 28. *(State Fund.)*

SKIN VACCINATION FOR FOWL POX

The presence of chicken pox each fall in commercial flocks in old and settled poultry communities has come to be expected. In fact, diseased birds have often been introduced in flocks to cause an early infection so that the disease would run its course while the birds were still on the range. Believing that a more definite method of immunization is necessary, E. M. Gildow has experimented with skin vaccinations for chicken pox in poultry with a non-attenuated virus. The object was to determine the efficiency of the immunity produced, its effect on egg production and mortality, the duration of the immunity, and to investigate any factors which might develop.

To find the best age at which poultry could be safely vaccinated and the most satisfactory number of follicles to infect, the birds were separated into four groups, one at 2½ months, the second at 3½, the third at 4½, and the fourth lot at 5½ months. Each lot was separated further into four groups of five birds each, and three, six, nine or twelve follicles were infected with the virus. It was found that the smaller the number of follicles infected, the greater was the gain in weight shown by the pullets. The lot with three follicles infected gained a total of 8 lbs.; six follicles, 6 lbs. 9 oz.; nine follicles, 5 lbs. 9 oz.; and with twelve follicles infected, the gain was but 3 lbs. 14 oz. There was little difference in the weight gain between the groups of birds vaccinated at the four different ages.

Eleven months after vaccination, nine of the pullets taken from the original lots were inoculated by rubbing virus in the comb, after it had been scarified. Every three weeks thereafter data were taken to determine definitely the time of development of lesions. No evidence of fowl pox developed in the pullets previously vaccinated; in fact, they continued to gain weight, and four of the five pullets began laying. However, the control pullets showed fowl pox lesions. From this test one would conclude that birds vaccinated between 2½ and 5½ months of age, with at least three follicles infected, retain the immunity developed for at least eleven months.

To check up on the possible transmission of the disease to normally healthy birds, three cockerels were placed with the pullets for five months. No evidence of fowl pox lesions developed. In later tests two of them proved susceptible and the third immune. These data suggest that vaccinated birds may be placed with clean susceptible stock four months after vaccination without danger of spreading the disease.

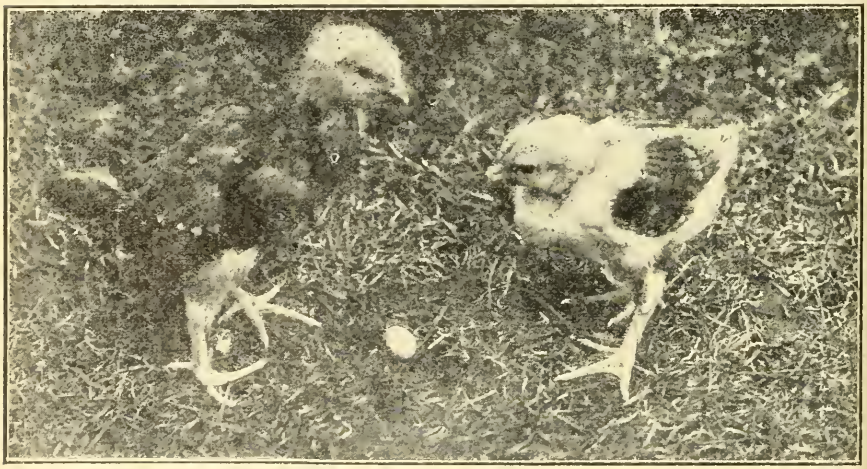
Five commercial flocks were vaccinated, and it was found that a slight disturbance occurred in the amount of feed consumption within three weeks after vaccination. The birds, as a rule, recovered their appetites within a week. There was no apparent correlation between food consumption and egg production. The egg production in all cases remained the same or showed a normal increase. *(Purnell Fund.)*

DO SLOW FEATHERING BIRDS GROW FASTER?

Poultrymen, in general, have assumed that slow feathering Rhode Island Reds grow faster than rapid feathering ones. However, when the birds of a flock were separated into pullets and cockerels and weighed in groups, E. M. Gildow found no appreciable difference.

One group of 1,016 chicks was separated at 15 days into slow feathering and rapid feathering groups. The development of the tail feathers and the extent of wing feather growth were two of the factors that determined the classification. The 462 rapid feathering chicks weighed 94 pounds and averaged .2034 pound apiece; and the other group of 554 slow feathering chicks weighed 112 pounds and averaged .2003 pound.

Rapid feathering pullets and slow feathering cockerels predominated. When the chicks became cockerels and pullets and 65 days old it was found that the rapid feathering pullets weighed an average of .36 pound more,



Rapid and slow feathering chicks at 35 days of age

while the rapid feathering cockerels weighed an average of .2 of a pound less than the slow feathering individuals.

Very similar results were obtained from another test with 347 Rhode Island Red chicks. *(Purnell Fund.)*

PREVENTING THE SPREAD OF COCCIDIOSIS

Coccidia remain alive in contact with most forms of disinfectants; but recent discoveries have shown that iodine, especially in the free form, kills them. With this in mind, E. M. Gildow experimented with iodine suspensoid in poultry houses as a means of preventing the spread of coccidiosis. This treatment was linked with the ordinary sanitary measures used to combat the disease and prevent worm infestations.

Four lots of broilers of about 1,000 birds each were raised in houses given the iodine treatment. Three treatments were given each flock, one

before housing, one before the outbreak of coccidiosis, and one after the outbreak. In line with the experience of broiler producers throughout the state, each succeeding lot showed an increasing amount of coccidiosis. The variation ranged from 5.8 percent at 11 weeks with the first to 16.5 percent with the fourth lot. The iodine suspensoid treatment did not prevent the development of acute coccidiosis. The birds grown this year made better growth with a lower mortality than in previous years when no iodine treatment was given, but it is questionable whether iodine suspensoid is adequate where the organism has an opportunity to multiply over a long period of intensive broiler production. It seems from this that it is inadvisable for poultrymen, other than broiler specialists, to attempt to produce a large number of broilers prior to the production of stock for egg production. *(Purnell Fund.)*

ELIMINATING MOSQUITOES FROM COASTAL MARSHES

In the spring of 1928 a careful study was undertaken by P. R. Lowry as to the mosquitoes found in southeastern New Hampshire along a portion of the coast. The investigation was planned to include collections of mosquito larvæ and adults at frequent intervals, study of breeding places, determination of the species involved and collection of other data that can be made the basis of a report on the mosquitoes of the region in question and eventually the basis for a plan of control.

This work has been prosecuted carefully and a satisfactory amount of data is accumulating. So far as known this is the first careful survey of the mosquito problem in a coastal region as far north as that included in the study.

Thirty-seven species of mosquitoes have been found in New Hampshire, of which 20 attack man. Eleven of them are prevalent along the coast, where the salt marsh species is by far the most numerous. Investigations point towards drainage of the coastal marshes as the most feasible means of eliminating the pests. The other two methods, oiling and filling, are not so practical, for the topography of the region lends itself readily to drainage at a low cost. *(Hatch Fund.)*

EUROPEAN CORN BORER IS NOT MAKING PROGRESS

The fifth year's investigations with the European corn borer under New Hampshire conditions bear out the earlier assumptions, reports W. C. O'Kane, who finds no increase in the numbers of borers. The density of population of the pest remains too light to yield any data on insect parasites or preferences for different plants for food. The life history of the insect in this state shows two generations of the insect each year, and this fact defeats its opportunity to increase. The second generation is too immature to pass the winter successfully, and reproduction depends entirely on the larvæ that exhibit but one generation. However, the one-generation phase of the insect is moving eastward, and in all probability will overlap the New England two-generation phase before long. What the result of this will be, no one can predict. An increase in the number of one generation larvæ in New Hampshire may bring about destructive abundance. *(Adams Fund.)*

LIFE HISTORY OF THE WHITE PINE WEEVIL IS COMPLETED

Gaps in the life history of the white pine weevil have been accounted for during the past year. A large number of individuals have been followed by W. C. O'Kane through a complete generation from the laying of the egg to the emergence and maturity of the adult. Apparently, some weevils live for two years, and if the number of individuals that exhibit this lengthened cycle is sufficient, this fact may explain some failures to secure control by elimination of infested white pine leaders at the time weevils are in them in the larval or pupal stages.

Proof is secured that the white pine weevil, *Pissodes strobi,* is identical with the so-called species *Pissodes approximatus,* which is found attacking the roots of stunted white pines. Apparently the *P. approximatus* represents an infestation of *P. strobi,* resulting from egg-laying near the ground instead of on the leaders.

Several species of parasites have been collected which may assist in control. *(Purnell Fund.)*

PENETRATION OF CONTACT INSECTICIDES

Observations on the ability of contact insecticides to penetrate through the integuments of different insects begun by W. C. O'Kane seem to indicate strongly the vital importance of a chemical compatability between the chemical structure of a spray material and the structure of the integument of the insect.

Indications are that different groups of insects give different performance in the matter of penetration and toxicity, which is due probably to the differences in the nature of the integument. *(Hatch Fund.)*

VARIETY TESTS OF PLUMS

Japanese sorts of plums such as Burbank and Abundance produce excessively heavy crops. These are not of high quality, and in 1928, reports L. P. Latimer, were marketed with such difficulty that it was often questionable whether or not the cost of picking and transportation to market could be obtained. The European plums produced good crops this season, but are much more subject to brown rot than the Japanese sorts. This disease was more serious than usual, owing to excessive rain. Several of the Reinette type, namely, Washington, Jefferson, and Imperial Gage, all varieties of white or green flesh, produced fruit of exceedingly high quality this season. Lombard again proved to be the heaviest bearer among the European types. All of the European plums found a very ready market. Our experience in recent years indicates that these sorts deserve wider planting, at least on a small scale. *(Hatch Fund.)*

APPLE PRUNING EXPERIMENT

A good crop of fruit was harvested this year from both the McIntosh and Northern Spy trees in the pruning experiment. G. F. Potter's review of the records indicates that the prunings for ten years from those trees have amounted to about 15 to 20 pounds of wood each. This has been sufficient in the case of the modified leaders to train the trees to an excellent type of head, in which seven or eight main lateral branches are

well distributed over a distance of 2½ to 3½ feet along a central trunk.

Heavy pruning is known to delay bearing, but the average yield of more than half a box per tree from the ten-year old Northern Spy trees is an excellent early return for this variety, and indicates that a certain amount of pruning will give good results without too great a sacrifice in early crops. The McIntosh trees this season, in spite of the fact that rainy weather at blossom time very materially reduced the set, produced about 40 pounds, or nearly one box for each tree.

In both McIntosh and Spy the production was slightly less on trees of the full leader type than on those trained to semi-leader or vase. This is not due to smaller size of trees because the trees in this plot are favorably situated and measurements of trunk diameter show that they are fully as large as any other trees in the plot. The results seem to indicate that the type of pruning necessary to train to a full leader type has reduced the bearing area. Prunings this season were slightly heavier in the full leader type than with the modified leader tree, but were materially lighter in the case of the vase form trees than with either modified leader or full leader. *(Hatch Fund.)*

FERTILIZING PEACHES

Experiments with fertilizers on peach trees continue to show that nitrogen is the most important element necessary to good yields. In the heaviest crop yet harvested the increase due to the application of two pounds of nitrate of soda per tree was 24 pounds of fruit. This is an increase of about 30% over the trees not receiving nitrogen. Contrary to previous experience, trees receiving potash in addition to nitrogen failed this year to produce more than those receiving nitrogen alone. *(Hatch Fund.)*

EFFECT OF FERTILIZER ON STRAWBERRIES

A large strawberry plot of Howard 17s was fertilized at the rate of 20 tons of manure an acre, and was subdivided into 8 fertilizer treatments. The fertilizers were spread broadcast and worked into the soil before planting.

The greatest effect was shown in the number of new plants formed. The plots that received 1,500 pounds of acid phosphate, in addition to the 20 tons of manure an acre, produced about 20% more runner plants, and the plots receiving 20 additional tons of manure about 30% more than the other plots.

The yield per acre under these two treatments was not greatly different in spite of the increased number of plants. This was probably due to the crowded conditions in the plots which caused a reduction in the number of flowers produced per plant. The plots receiving an additional 20 tons of manure produced the largest number of runner plants per acre, and also produced the lowest number of flowers per plant. The lowest plant-producing plots were those that bore the greatest number of flowers per plant. The total number of flowers for each acre was about the same in both cases.

The effect of the fertilizers on the size of fruit was not marked. There was little variation in size. The tendency was for the plots receiving 20 extra tons of manure to produce the largest fruit; fruits from these plots weighed about 10% more on the average.

There was little difference in the total yield. The best yield was obtained from plants that received the extra heavy application of manure; here the increase was 10 to 15 percent, which may have been due to increased size of fruit. *(Hatch Fund.)*

APPLE POLLINATION

In spite of cold weather before and persistent rain during the blossom period, further data on pollination were obtained in 1928 by L. P. Latimer. This season, as last, tests in which the petals were removed from the flowers proved McIntosh self-sterile under the prevailing climatic conditions. The removal of the petals prevents the bees and other insects, which are responsible for cross-pollination, from visiting the blooms, and renders it necessary for them to be fertilized by their own pollen only. The depetaled spurs are not bagged, nor is the tree placed under a cage. They are compared with alternate spurs on the same branches to which insects bring various kinds of foreign pollen. The depetaled McIntosh spurs set no fruit, while the cross-pollinated spurs that alternated with them on the same branches set 16 percent. By this same method Gravenstein was found to be self-sterile, but Wealthy produced a high percentage of fruit on flowers without petals, and accordingly must be self-fertile.

Good sets of fruit on Gravenstein were obtained with Wagener pollen on flowers that were both emasculated and bagged. Red Astrachan and Oldenburg pollens produced fruit on flowers which were bagged but not emasculated, but Baldwin, McIntosh, Delicious, and Gravenstein pollen produced no set under any conditions. The wound inflicted in emasculating apparently reduced the chance of the flower to set fruit. *(Hatch Fund.)*

BREEDING TOMATO PLANTS

Records of growth and production from first generation hybrids of several varieties of tomatoes have been summarized by J. R. Hepler. Approximately 72 plants each of Bonny Best, Dwarf Champion, Ponderosa, Earliana, Sunrise and 20 different first generation hybrids of these varieties were planted in eight replicate plots. Records were made of the number and weight of fruits on each plant, and for 21 plants of each strain, records were also made of the amount of growth produced and blossom clusters formed.

The results indicate that the crosses are more vigorous than the parents. The increased growth of the hybrid as compared to the average for the two parents varied from 12½ to 136 percent. The average growth for all 20 of the first generation hybrids was about 62 percent greater than the average for the five parent varieties.

In yield the crosses outstripped their parents by from 12 to 89 percent, averaging 42 percent higher. The increased yield was due to a larger number of fruits which, on the average, were somewhat smaller than those borne by the parents. The size of fruit on the crosses seems to be similar to the size of fruit on the smaller-fruited of the two parents. This was especially true in crosses of the Sunrise variety, in which the fruits on the average weighed less than three ounces each. *(Hatch Fund.)*

THE VOLUME OF ROADSIDE MARKETING

An investigation of the roadside markets distributed over 1,000 miles of the main highways of the state shows 800 places where roadside selling is done. Complete records for 103 stands were taken by M. G. Eastman. Total sales for each stand averaged $2,700. Five stands sold over $10,000 worth each, and only 8 sold less than $500.

Gas and oil represent 29% of the total sales; purchased food, candy, etc., 20.9%; farm-raised products, 19.3%; farm prepared foods, 18.1%; farm products purchased and sold, 4.9%; miscellaneous, 4.8%, and lodging, 3%.

About 30% of the sales were made on Sunday and 19% on Saturday; the other days averaged from 9 to 11%. July and August were the busiest months, when over half the business was done. The total value of labor for each stand was slightly over $1,000. Wages for men, women and children

A typical New Hampshire roadside stand with a variety of products from vegetables to balsam pillows

varied from 15½c to 43c an hour. Only 11.2% of the labor was hired. In general the cost of hired help was slightly more than the estimates for value of home labor.

A study of a second group of 100 miscellaneous stands of smaller size showed total sales averaging about $1,000 each. *(Purnell Fund.)*

SOIL FERTILITY IN THE GARDEN

Danish Ball Head cabbage was grown in 1928 on the permanent soil fertility plots by J. R. Hepler. A heavy application of manure, 32 tons per acre, was compared with more limited applications of stable manure supplemented by commercial fertilizers. Practically equal results were secured from the two sets of plots. One-half of each plot was limed at the rate of 2,000 pounds per acre in alternate years. The limed half of the plots

produced no more cabbage than the unlimed. In some supplementary tests different forms of nitrogen to the equivalent of that contained in an application of 500 pounds nitrate of soda per acre were applied to several plots of carrots. The results indicate that nitrate of soda, urea, ammonium sulphate, potassium nitrate, Leuna saltpeter, and calurea are equally desirable as sources of nitrogen for this crop. A slightly increased yield, possibly not significant, was obtained in the plots in which calcium nitrate and nitrophoska were used. *(Hatch Fund.)*

SPRAY SERVICE

Tests were made this season by E. J. Rasmussen on the feasibility of determining more definitely the proper time to spray for apple scab and codling moth. Efforts were made to determine the stage of development of the apple scab fungus, and the date when ascospores would first be ready to discharge. The variation in development of the fungus in the various orchard locations on the rolling hills of southern New Hampshire appears so great that further study will be necessary before trustworthy information can be furnished to fruit growers.

Tests were made of the feasibility of determining the date of egg laying by codling moth through the use of bait traps. All told, 1,115 moths were caught between June 15 and August 15 in 110 traps placed in eleven orchards in four counties. The experience thus far indicates that this method gives a rather reliable indication of the time that the eggs are deposited, which in 1928 was considerably later in the season than previous investigations had indicated. The tests indicated that the commercial product Diamalt is much superior to fermented glucose syrup for the purpose of attracting the moths. *(State Fund.)*

FOREST STUDIES SHOW RESULTS

Studies with forest plots at the Station have shown the following facts, reports K. W. Woodward:

(1) That white pine on heavy clay soils is overtopped and crowded out by hardwoods within ten years after seeding.

(2) That Scotch pine is in every way inferior to white and red pine. It does not grow any more rapidly and produces much inferior wood. Besides, seed of suitable origin is difficult to obtain.

(3) That pure white pine stands will yield a cord per acre per annum in thinnings between 30 and 50 years.

(4) That thinning white pine stands produces better quality and bigger trees, and more volume per acre in a given time. *(Hatch Fund.)*

THE EFFECT OF POTASSIUM DEFICIENCY ON METABOLISM IN PLANTS

In an effort to find the effect a lack of potassium in the nutrient solution has on plant growth, T. G. Phillips and T. O. Smith grew tomato and radish plants in sand cultures of three types: a complete nutrient solution; a solution containing one-tenth the amount of potassium in the first; and a solution wholly lacking in potassium. In the radishes a soluble carbohydrate was discovered which is easily hydrolyzed by acids but is not sucrose. The plants grown in the complete nutrient solution contained an abundance

of the carbohydrate; those grown in the solution containing one-tenth the potassium contained very much less; while the third group contained practically none. Similar differences, although not so marked, appear in the tomato plant analyses. *(Adams Fund.)*

DETERMINING HARDINESS BY ANILINE DYE ADSORPTION

The suggestion that relative hardiness of different varieties of apples may be ascertained by studies of adsorption of certain aniline dyes by pulverized apple twig tissues was further investigated by Stuart Dunn. Experiments were also made with alfalfa and cabbage. Twelve varieties of apples were tested from samples collected in December and March. McIntosh and Baldwin both checked with growers' experiences; McIntosh was found to be most hardy of the varieties, and Baldwin was either the least or next to the least hardy. With other varieties, however, it can only be said that they remained grouped in either the most hardy half of the scale or the least hardy half.

Roots of Kansas Common, a tender variety of alfalfa, and Grimm, a hardy variety, were tested for dye adsorption in February, March and April. In February and March the experiments checked with the known hardiness of the two varieties, but in April the reverse was true.

The effect of hardening cabbage plants on the rate of dye adsorption was studied. Plants were grown at 3° C. and 23° C. The tests showed that the longer the period of time the plant was hardened the greater was the amount of adsorption. *(Adams Fund.)*

PREHEATING SEED TO CONTROL BEAN ANTHRACNOSE

Studies on the control of cotton anthracnose in North Carolina have shown that heating the seed 80° C. to 95° C. killed the seed-borne elements of the fungus. Preheating at temperatures of 45° C. to 60° C. enabled the seed to withstand higher temperatures without much loss.

Stuart Dunn followed the same lines of this experiment for the control of bean anthracnose. Under similar circumstances bean seed treated at higher temperatures without preheating at lower temperatures showed a greater resistance to heat than cotton seed.

Healthy and diseased Red Kidney and Bountiful beans were preheated in different groups of samples at 50° C. for 20, 21 and 26 days and afterwards heated at 80, 85 and 90° C. for a period ranging from 2 to 18 hours. Periods of 4 to 10 hours of higher temperatures least hindered the healthy seed, and all but a small percentage of the diseased seed was killed.

Disease-free seed of Red Kidney and Yellow Eyed beans was produced, and will be distributed to growers interested in producing seed beans for market. *(Hatch Fund.)*

HERBICIDES FOR MUSTARD

A search for a satisfactory herbicide for the control of mustard is under way, in charge of R. Bissey. Herbicides are generally thought to be more

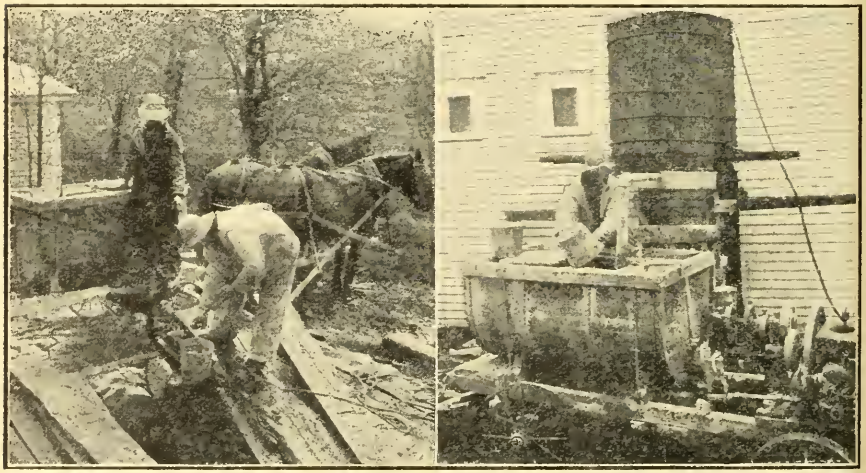
active when dried slowly. However, of all the substances studied this was true only of nitrate of soda. Copper nitrate, copper sulphate, sodium hydroxide, ammonium sulphate, sodium carbonate and sulphuric acid are more active when dried quickly.

To obtain an 80 percent kill a necessary strength of the herbicide was found to be for copper nitrate 1%; sulphuric acid 1.5%; copper sulphate 1.8%; ferrous sulphate 10.0%; and ammonium sulphate 36%. *(State Fund.)*

TIME STUDIES IN ORCHARDS

Filler trees in apple orchards have little value under New Hampshire conditions with cheap land and the sod mulch system, according to the economic fruit studies being made by H. C. Woodworth and G. F. Potter. Even with permanent trees, the highest value, based on expected earnings, seems to come at twenty years of age. On account of the piling up of costs by compound interest the importance of having a tree come to bearing early is clearly shown. An early-bearing tree may have paid for itself at 16 years of age, while a late-bearing tree may require 27 years.

The time studies indicate that two skilled men can care for 3,000 trees with extra unskilled help at certain seasons. In growing the fruit, pruning, spraying and thinning require special training and skill and must, therefore, be done by the orchardist himself and the crew of trained men. Picking up brush, fertilizing, tillage, mowing, mulching, protection, propping and picking apples may be done by men of ordinary intelligence upon short instruction. Thinning also could be done satisfactorily by the better class



More efficient methods in this orchard have saved time and labor in filling the spray tank

of day labor available. It is thought, therefore, that in the case of large

orchards the amount and distribution of labor on pruning and spraying should receive special attention. In the case of pruning there is much leeway as to time, since December, January, February, March and April may be used for this purpose. The amount of skilled labor needed in pruning can be spread over this period of five months.

If we assume that on the average the weather conditions are such that about 80 hours are available for pruning in each of the months of December, January, and February and that in March and April approximately 120 hours are available per month, we then have a situation where each man can put in 480 hours per year in pruning trees advantageously.

On the basis of 10 farms with 13,500 trees in 1926, 2,500 hours were used in pruning. This is about 11 minutes spent in pruning per tree, and if this were a fair basis one man in 480 hours could prune orchard, and if this were a fair basis one man in 480 hours could prune 2,600 trees. Since, however, some orchards were not pruned very much, it may be more correct to take data from the two large orchards where pruning is done yearly in an effort to keep up each season. In one of these, with about 3,000 trees of all ages, 1,263 hours were used in pruning in 1927 and 849 hours in 1926. In the other, with about 3,000 trees of varying ages, 964 hours were used in pruning in 1927 and 259½ in 1926.

It is therefore believed that two skilled men could prune an orchard of 3,000 trees, especially if one unskilled man were available to do tasks laid out by the trained men. The actual cost of the work can be made less if some productive work can be done when weather is not favorable for pruning.

Spraying, of course, is more or less definite as to time and probably is the peak in skilled labor requirement. On the average there is approximately the following time period for the various sprays: dormant spray, 10 days; prepink, 5 days; pink, 5 days; calyx, 5 days; 1st cover, 12 days. Since, however, there will be windy or rainy weather, it is thought that the large orchardist should be equipped with machinery and personnel to cover the orchard in 40 hours. In some years this may necessitate considerable night work.

The spray program seems to vary greatly. Yet even though only one spray is applied, the necessity of putting this on within the limited time is obvious. In 1926 in one large orchard the calyx spray was applied to over 3,000 trees in 31 machine hours. In another it required 63 machine hours or 189 man hours. In the case of both these orchards at this rate of spraying, one machine and one crew could hardly complete the spray on time in many years. One orchard had two machines and two crews and put most of the spray on in 3 days. In the other over 5 days were required to put the spray on.

The former orchard normally has 6 to 7 men on account of other crops so that the crew is available at any time; but in the latter only apples are produced, and if two crews were used in spraying there would be nothing for these men to do at other times, so that by spreading the work over a longer time one crew can do the work. In this case, however, a dusting machine was held in reserve. This dusting machine was used in later sprays and the orchard covered in 13 to 18 machine hours. *(Purnell Fund.)*

BURGUNDY MIXTURE FOR SPRAYING

In continuation of the studies of fungicides, O. Butler has made investigations of Burgundy mixture during the year. Using a 1:1.81 mixture, he finds that while the method of mixing and the temperature do affect the rate of settlement, the effect produced is less marked than in the case of Bordeaux mixture. Mixtures in which the ratio copper sulphate to sodium carbonate is 1:1.5 or higher were found to decompose with the formation of malachite, mixtures in which the ratio is 1:1 with the formation of a blue copper carbonate.

In studying the effect of spraying on the dry matter formed in plants, sunflowers and beans were used. The beans sprayed with Burgundy mixture were somewhat injured; in the case of the sunflowers the effect produced was very similar to that secured by spraying with neutral Bordeaux mixture; i. e., there was an increase in the dry matter formed. *(Adams Fund.)*

POST-MORTEM EXAMINATIONS

The difficulties with disease that confront poultrymen may best be shown by a summary of the specimens received for post-mortem examinations in one year's time at the Station laboratory.

A total of 2,729 individual specimens was received, of which 2,625 were poultry. Bacillary white diarrhea again leads the list with 703 specimens, of which 668 were chicks. Over 90% of these chicks are believed to have come from out-of-State or non-accredited sources, a large proportion of them from commercial hatcheries. Pneumonia cases totaled 421; coccidiosis, 417; paralysis, 151; and enteritis, 96.

During the latter part of the season, due to the cold, wet weather, large numbers of specimens showing coccidiosis were received. A total of 417 was recorded for the year as against 364 last year; 201 of these specimens were cases of cecal or acute coccidiosis and 216 of them chronic or duodenal.

A pathological condition showing approximately the same lesions as chronic duodenal coccidiosis and found in the same class of birds was enteritis, with 96 specimens in which no evidence of coccidia could be detected. Included in the 216 specimens with chronic coccidiosis and the 96 with enteritis, 151 birds were found showing typical symptoms of paralysis. In practically every instance where paralysis was present there was enteritis accompanying it and in most instances duodenal coccidiosis. This tends to substantiate our experimental conclusions that paralysis in New Hampshire is very closely associated with coccidiosis.

Cases of pneumonia numbered 421 as against 290 for last year, and in practically every instance were associated with bacillary white diarrhea in young chickens. A very small percentage, probably not over 20%, were cases of pneumonia due to brooding faults.

A condition locally termed "crazy chicks," occurring sometime during the third or fourth week of the chicken's life, has become quite prevalent, 135 specimens having been diagnosed as such. The symptoms are an unsteady gait, loss of equilibrium, tipping back on the tail-head, getting down on the floor and kicking around in a circle and complete refusal of food. In practically every case the affected chicks die. In most instances the

largest and best developed chickens are the ones that show this trouble. There is a loss of color in the legs and an inflammation of the small intestines. Occasionally coccidial forms are present, but in some instances no evidence of coccidia can be detected nor do the chickens subsequently come down with coccidiosis. However, in most instances, chickens suffering from this crazy chick disturbance subsequently come down with an acute form of coccidiosis. No definite cause for this condition has been found, but irritation of the intestinal tract is suspected. Irritants in the feed, such as spoiled feeds, cold water for very young chickens and acute coccidiosis, all produce these typical symptoms. In some instances the use of a poor grade of cod liver oil or the use of too much oil has been suggested, since the discontinuance of the oil appears to check the trouble. The use of a 40% powdered milk mash has checked it in every instance in which treatment has been advised.

Twenty-nine cases of Vitamin A deficiency were diagnosed. In every instance the chicks had been fed on a commercial feed, and a low percentage of yellow corn and the absence of green feed are considered responsible.

The more acute infectious diseases, including fowl typhoid and chicken-pox, did not increase in the state. Two new flock infections with chicken-pox were reported and in four flocks the disease was eliminated. A definite policy in regard to the prevention of the introduction of these more acute diseases has been followed rigidly during the past three years. In most flocks chicken-pox has been introduced through the purchase of breeding cockerels. Since it is well known that many poultry diseases are carried over from year to year in mature birds, this practice has been discouraged, and the introduction of new blood secured through the purchase of hatching eggs or day-old chicks from accredited flocks. *(State Fund.)*

TESTING FOR WHITE DIARRHEA

In the white diarrhea testing campaign 79,539 birds were tested in 159 flocks during the period from May 15, 1927, to March 30, 1928. About 20,000 of the birds were hens and 60,000 pullets, of which 2,121 proved reactors. The percent of infection was 2.92, about .8 percent greater than last year. Twelve new flocks were added to the accredited list from 63 candidates. Five flocks were removed from the list. There are now 54 flocks on the accredited list, containing 36,330 birds.

Due to the safety value received from testing before the hatching season, to the reinfestation of a few accredited flocks each year and to the misleading advertising that has been carried on by flock owners in regard to bacillary white diarrhea accreditation, a definite change in the regulations has been made to guard against these troubles.

When a flock has been subjected to an official test before the breeding season, in which all of the birds on the farm have been tested and found to be without reactors, the flock shall be classified as "Tested for Bacillary White Diarrhea and found to be Without Reactors" and the flock owner's name shall be placed on a list so named.

When a flock has been subjected to two tests, one before the breeding season, including all of the birds in the flock, and the other after June 1 of the following summer, including all the birds in the flock, which must represent at least 60% of the original birds tested and found in both tests to

be without reactors, the flock shall be classified as "Accredited Free from Bacillary White Diarrhea" and the flock owner's name shall be placed on a list so named.

When any bird is found positive on any retest of an accredited flock or when *Salmonella pullora,* the organism responsible for bacillary white diarrhea in chicks, is isolated from chicks that can be traced directly to an accredited flock, that flock shall lose its accreditation and shall not be reaccredited until such flock has passed two tests as required for a flock accredited free from bacillary white diarrhea.

All poultry, hatching eggs, or baby chicks to be added to accredited flocks, or flocks in the process of accreditation, shall be reported to the poultry pathologist, giving the identification of such poultry and the name and address of the person from whom purchased. All such poultry, hatching eggs or baby chicks shall be from accredited flocks.

Violation of the letter or spirit of these rules and regulations shall be considered sufficient cause for the immediate cancellation of certificate of accreditation.

The charge for each test shall be 10c per bird. *(Miscellaneous Income.)*

POULTRY CERTIFICATION INCREASES

During the season of 1927-28 a system of poultry certification was begun, and approximately 22,579 birds were handled for certification by H. O. Stuart. Only accredited flocks are given certification. The purpose of the work is to separate the hens into three classes depending on their ability to produce chicks having the qualities needed for high egg production.

The first is the breeding class and contains all the birds that show satisfactory production qualities and are free from any inferior qualities which might be inherited. The second class contains birds suitable only for egg production. They may be off-type in color from the rest of the flock, off-color ear lobes, have side sprigs, feathers on shanks, have a comb foreign to the breed, or have "down" on their shanks or toes. Any one of these defects makes a bird undesirable for breeding stock. The third class is made up of culls unfit for economical egg production or breeding stock.

About 3,435 birds were also handled in selecting breeding stock from non-accredited flocks. *(Miscellaneous Income.)*

POTATO CERTIFICATION

Sixty-eight acres of potatoes were inspected and passed for certification. A total of 75 acres was inspected. The fields of ten young farmers aged between 16 and 21 were among those certified. *(Miscellaneous Income.)*

INSPECTION SERVICE

Feeding Stuffs

In connection with the enforcement of the law regulating the sale of concentrated commercial feeding stuffs, 376 samples of these materials were analyzed for the State Department of Agriculture. About 3,100 individual determinations were made in carrying out these analyses. The results are reported in the annual inspection bulletin.

Fertilizers

One hundred and twenty-eight samples of commercial fertilizers were analyzed for the State Department of Agriculture, involving about 900 individual determinations. The results are being published.

Miscellaneous Analyses

Samples of foods, fertilizers, soils, pests, lime and wood ashes have been sent in by residents of the state. Of these, 160 have been analyzed, involving 279 individual determinations. Many inquiries not involving analysis have been answered.

Seed Testing

The seed inspection work for the State Department of Agriculture was carried on as usual, and 377 samples were handled by the laboratory. This included 314 collected by the state inspector, and 63 private samples. *(Miscellaneous Income.)*

PUBLICATIONS ISSUED DURING THE YEAR

Station Bulletin 229—Results of Seed Tests for 1927.
" " 230—Inspection of Commercial Feeding Stuffs, 1927.
" " 231—Inspection of Commercial Fertilizers, 1927.
" " 232—Agricultural Experiments, 1927.
" " 233—Electric Dairy Cold Storage.
" " 234—Marketing Live Broilers in New York City.

Technical Bulletin 35—Some Physical and Physiological Activities of Dairy Cows.
" " 36—Spray Solutions and the Control of Apple Scab.
" " 37—Wool Covering on Face, Ears, and Legs.

Station Circular 27—Coccidiosis in Chickens.
" " 28—Anti-Rachitic Values of Cod Liver Oil, Cod Liver Meal and Fish Meal.

FINANCIAL STATEMENT

EXPENDITURES OF THE NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDED JUNE 30, 1928

	Hatch Fund	Adams Fund	Purnell Fund	Supplementary*	Total
Salaries	$ 9,742.46	$12,174.00	$25,951.36	$16,009.71	$ 63,877.53
Labor	786.05	1,204.07	3,787.65	3,731.72	9,509.49
Stationery and office supplies	161.85	67.01	73.44	275.82	578.12
Scientific supplies, consumable	79.85	356.19	474.02	487.29	1,397.35
Feeding stuffs	None	131.06	131.50	563.90	826.46
Sundry supplies	119.12	90.63	492.44	3,221.44	3,923.63
Fertilizers	68.93	None	250.42	74.20	393.55
Communication service	602.65	None	34.50	148.78	785.93
Travel expenses	655.89	140.90	3,264.54	3,754.53	7,815.86
Transportation of things	312.21	23.91	52.49	97.27	485.88
Publications	856.31	.....	584.87	702.51	2,143.69
Heat, light, water and power	700.00	None	None	298.35	998.35
Furniture, furnishings and fixtures	63.88	92.71	685.93	128.48	971.00
Library	362.18	None	24.47	298.65	685.30
Scientific equipment	460.22	63.30	912.63	585.20	2,021.35
Livestock	None	None	331.00	None	331.00
Tools, machinery and appliances	2.15	282.88	620.62	712.00	1,617.65
Buildings and land	24.57	371.84	2,314.05	602.55	3,313.01
Contingent expenses	1.68	1.50	14.07	55.35	72.60
Unexpended balance	None	None	None	2,459.37	2,459.37
Totals	$15,000.00	$15,000.00	$40,000.00	$34,207.12	$104,207.12

* This fund includes expenditures from the following sources:

State Appropriations	$ 5,500.00
Sales and Miscellaneous Income	28,707.12
	$34,207.12

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

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Walter C. O'Kane, M. A., *Entomologist*
Ormond R. Butler, Ph. D., *Botanist*
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